Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

NOTES ON THE DISTRIBUTION OF TIMBER IN SOUTH-WESTERN IOWA, WITH INFERENCES CONCERNING THE ORIGIN OF PRAIRIES.[1]

BY PROF. J. E. TODD.

UPON the bluff deposit of Western Iowa is found an unusually favorable field for testing the theories concerning the much-vexed question of the origin of prairies, or rather the origin of forests, for doubtless the former are necessarily the older conditions of most regions.

The soil over wide areas is almost perfectly uniform, and so deep that no underlying formation can thrust in its influence to complicate the problem. The surface is almost infinitely varied; the high plain which is the summit of the loess, the low alluvial plains and hill-sides and bluff-sides presenting every conceivable angle of inclination, and dipping in every possible direction. To produce even greater variety, ledges of rock and knolls of gravel occasionally appear.

I.

In such a region timber occurs in the following circumstances:

(1.) In the hill-regions where the slopes are inclined from 5° to 10°, it is found much the most generally on the northern slopes just south of creeks flowing east or west. This was noted some years since, by Mr. J. A. Allen.

Timber is found in the same region a little less frequently on western slopes, east of creeks flowing north or south. On the same streams considerable timber may occasionally be found on the west side. All other portions of the hill region are uniformly destitute of trees.

(2.) In the bluff region, where the slopes are from 10° to 45°, just east of the bottom lands of the Missouri river, timber is found over most of the surface, forming a belt from one to five miles in width, in Fremont county, and extending northward through Mills and Pottawattamie counties, with a narrowing and more interrupted course till it fades out in Harrison county. This belt is usually bounded on the west by the crest of the most western ridge of bluffs, leaving the slopes facing the bottom land bare, except in two well-marked cases; the first, when a lake, slough or stream comes close to the base of the bluffs; the second, when the bluff-side is deeply furrowed with ravines. In the former case the slopes are covered with bushes and scrub-oaks, often quite to the top. In the latter, the ravines are wooded, usually with the trees extending considerably higher on the south side than upon the north, and often the latter is scarcely wooded at all. These points are very evident to one riding over the bottom lands so far away as to get a general view.

---

[1] Read before the Iowa Academy of Science, September 26, 1877.

(3.) In the low alluvial valleys, the timber is found along the streams, usually in narrow strips, widening to fill the bends, and usually wider on the east and north sides of the stream. All other portions of the bottom lands are remarkably destitute of trees and bushes.

II.

The timbered areas are very constant, increasing very slowly if at all. This is indicated by the existence of old trees, over two hundred years old, within four or five rods of prairie, and the prairie showing no signs of having been previously timbered. Some of these cases were on the north side of groves, which side is most exposed to prairie fires, as the north-west wind usually prevails when the prairies are burning. Moreover after a personal acquaintance for the past twenty-five years with numerous localities in this region where the annual fires have been kept out, the writer has not yet learned of a single case where the advance of the timber has been more than five rods, and in the great majority of cases it has not been as many feet. He has not noted any cases of any destruction of timber by prairie fires except on the bottom lands, where the grass is much more rank and the timber is not protected by outlying hazel thickets as upon the upland.

Almost the only gain of timber land is due to seeds of the cotton-wood and willow finding lodgment on the bare surface of sand bars, "break offs," and where freshets break the turf, or cover it with a layer of bare earth. From such beginnings sometimes thrifty groves result, but quite as frequently the trees so started barely hold their own against their herbaceous foes, if not assisted by the favoring hand of man. In the slow advance of groves before alluded to, the *Rhus glabra* takes the front rank, and the hazel follows, preparing the way for elms, hickories, etc.

III.

These are the observed facts; what is their bearing on some of the theories advanced by different writers?

(1.) We find in Dr. White's report on the Geology of Iowa, Vol. 1, page 133, these words: "It now remains to say without the least hesitation that *the real cause of the present existence of the prairies in Iowa is the prevalence of annual fires.* If these had been prevented fifty years ago, Iowa would now be a timbered, instead of a prairie state. This view was fully endorsed by his assistant, Professor St. John. Although the distribution of trees as given above may seem to favor this theory, when we remember that fires occur mainly while the north-west winds prevail, and though it may be a slight factor in the problem, yet its inadequacy is clearly proved, not only by the constancy of timber areas whether the fires burn or not, but also indirectly, by their failing to make prairies of Ohio and New York, when the principle is made of general application. Dr. Newberry from a general survey of the subject, pronounces the idea "simply puerile" (Geology of Ohio, Vol. 1, page 30).

(2.) Professor J. D. Whitney has recently taken pains to reiterate his theory published some years ago, viz: that the cause of prairies, at least in states east of the Missouri river, is mainly in the fineness and depth of the soil, which he further ascribes to the nature and position of the rocks underlying. This theory is sufficiently disproved by the observations given above. In exactly the same soil totally different results are discovered.

(3.) The theory that the absence of trees is mainly dependent on the rain-fall, as is very generally held, is also proved to be faulty, if not false, for there is every reason to believe the rain-fall the same over most of the area under consideration. There may be an excess in the main bottom lands, but surely not on either side of the same ravine or hollow. This theory is also disproved most clearly by Professor Whitney in his article in the AMERICAN NATURALIST (October, 1876), in which he shows from Smithsonian rain-charts that the forest region of several States receives the least rain-fall, and the prairie region the greatest.

(4.) The theory advocated, as we understand, by Colonel J. W. Foster, and more recently by Dr. Newberry (Geology of Ohio, Vol. 1, page 30), is, that forests to flourish need "not so much a profuse as a constant supply of water," that a *deficiency* of *winter* *rains* and snow with "occasional though rare seasons of excessive dryness" characterize the prairie regions. This seems to come nearer explaining general facts, but though the underlying cause may be correct, viz: *constant moisture,* the means by which it is secured is certainly not that needed to explain the particular cases before us, for both timber and prairie, in the region under consideration, has, as before stated, the same rains and the same droughts.

IV.

From these theories, then, we have found nothing helpful for solving our problems, unless it be the idea of the *constancy of moisture.* Furthermore it seems quite clear that there is nothing very variable in the region observed, except the surface of the land and the distribution of streams. Can these factors secure the constancy of moisture required, in the circumstances where we have found trees, and the lack of such constancy where we do not find them? Let us see.

(1.) This constancy of moisture must be in one or both the *media,* in which the trees are located, viz: the soil and the air, and it is reasonable to presume that this constancy is to be looked for when the forces of vegetable life are in activity. Excess or lack of moisture at other times may be safely ignored.

(2.) We can readily see that moisture of the soil will be more constant on northern slopes than southern, because they are not so much exposed to the sun's heat. In spring they are many days later in drying up, so also after showers, and at certain degrees of humidity of the air, the northern slope may act as a *condenser,* thus collecting the moisture, which the opposite hill-side is giving off. These processes also affect the air, tending to secure a greater constancy on the northern slope. Moreover the same slope would be more protected, by its position, from the summer south wind, which occasionally is very hot and dry. These considerations may sufficiently account for the timber occurring on northern slopes and for its absence, in general, from southern slopes.

(3.) The prevailing winds of the region are westerly in spring and summer. This perhaps may sufficiently explain the preponderance of timber areas on the east side of streams flowing south, especially where the streams are of considerable size, and affording better opportunity for evaporation. This combined with the increased roughness of the surface of the country, may also go far toward explaining the timber belt observed in the bluff region. This becomes more obvious when we remember that the east side of the Missouri bottom lands, in the particular counties through which the timber belt passes, abound in sloughs and lakes, which are kept well filled by numerous springs and small streams; which fail to make their way across the bottom land to the river.

These causes also explain the occurrence of timber on the west face of the bluffs, where the moisture in the air counteracts the severe drainage of the abrupt slope and the intense drying action of the afternoon sun, which render other portions of the bluff-face almost destitute of even grass.

(4.) It remains to explain, if possible, the distribution of timber and prairie in the alluvial valleys or bottom lands. Here we have usually a slightly different soil, layers of clay preventing the ready drainage of many parts. These conditions render much of the surface too wet at all times, while other places are too wet in spring and too dry in late summer. These areas are found mostly in the eastern portion of the Missouri river bottom, because the surface there is lower and receives the water from springs and freshets from the bluff-region. The occurrence of trees along the streams and on ridges along old channels, on the other hand, may be explained partially by the inequality of surface, making the drainage of surplus water possible, so that moisture around the roots is more constant than elsewhere on the bottoms. The prairie fires, moreover, have been more efficient over the dryer portions of the bottom lands than elsewhere, because of the greater growth of grass and the free sweep for winds north and south.

V.

That the *constancy of the humidity of air and soil* is the most important factor in the formation of forests seems supported by further considerations taken from a wider field, which may be briefly indicated as follows: This theory explains the timber in areas of less rain-fall in northern Michigan and Wisconsin by their being traversed by moist winds, and not as subject to the hot rays of the sun as the southern portions of the same states. It explains the occurrence of timber upon mountains by a substitution of altitude for latitude in the preceding cases. It explains the distribution of timber in slightly hilly and level regions like the one under consideration, as has been shown above. It explains the existence of prairies where the rain-fall may be extreme even, for the precipitation of moisture may be caused by extreme changes of temperature, and the changeable climate which may produce much rain may also produce intervals of great dryness. It explains why the timber areas may sometimes correspond to geological formations, as urged by Professor Whitney. The soil either carrying the rain-fall away rapidly or retaining it; either cutting off the surface from the springs of water below, or drawing it up like a sponge; either rendering the climate more uniform by its better conducting power, or allowing the changes of the atmosphere to govern too perfectly the temperature of the surface of the ground. It may explain to some degree the fact that the grass of the prairie prevents the advance of timber in a hilly region by its preventing the showers entering and moistening the roots of larger forms of vegetable life. It also suggests certain means for securing the healthy and continued growth of groves, indicating the more favorable positions for them, showing methods of economizing the rain-fall in places where it may be scanty, etc.

In conclusion, therefore, while acknowledging that prairie fires, the amount and distribution of rain-fall, the nature of the soil, the temperature and inclination of surface, that all may have more or less importance in explaining the origin of forests and prairies; we may nevertheless be convinced that the *fundamental condition of forest growth is a constant medium humidity of air and soil.* Let us, therefore, *while not neglecting our pluviometers look more carefully to our hygrometers* in our study of this subject.

——:o:——

THE FIELD-WORK OF THE UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES, UNDER THE DIRECTION OF PROF. F. V. HAYDEN, FOR THE SEASON OF 1877.

ON the completion of the survey of Colorado last year, it was determined that the work of the United States Geological and Geographical Survey of the Territories, under the direction of Prof. Hayden should continue northward into Wyoming and Idaho. The belt of country including the Pacific Railroad having been explored